observation of the authors', and is interesting from the analogy with the early Mesozoic genus Anomozamites, in which each fructification is in a terminal position in the fork between two vegetative branches.

The anatomy of the peduncle agrees with that in Stangeria, centripetal xylem occurring in the upper part, while small, blind-ending bundles, often of concentric structure, are present in the basal region.

Nodules, perhaps comparable to those of the Leguminosæ, occur on the roots. The authors regard the sympodial organisation of Dioon and Stangeria as primitive, and hold that the monopodial growth of the trunk observed by Prof. Pearson in Encephalartos is clearly a later development, and connected with the production of several cones simultaneously.

(4) Though for many years past no one has doubted that the fossil cones grouped under Calamostachys were the fructifications of calamites, the direct proof of continuity has so far been lacking in the case of those specimens which, at the same time, show the internal structure preserved. In this memoir Mr. Thomas records the discovery of the well-known petrified fructification *Calamostachys Binneyana* in connection with the vegetative organs of the plant to which it belonged. He has also made some interesting incidental observations—the probable presence, below the lowest whorl of bracts, of a disc comparable to the annulus of Equisetum, the presence of hairs (rare in this family) on the axis, and the close agreement in structure between the bracts and the vegetative leaves. The author has also observed impressions of cones and leafy shoots, which he refers to the same species with the petrified specimens, identifying both with the *Paracalamostachys Williamsoni* of Weiss and the *Asterophyllites* (*Calamocladus*) *grandis* of Sternberg. He suggests, with good reason, that the name *Calamostachys Binneyana*, hitherto used for the structural specimens, may represent a type rather than a species. In discussing the morphological questions involved, the author rightly emphasises the homology between bracts and foliage leaves, so clearly brought out in his specimens.

(5) *Utricularia brachiata* is a small species from the Sikkim Himalaya discovered by Sir Joseph Hooker; it grows, at an altitude of about 11,000 feet, on the trunks of *Abies Webbiana*, among moss. The plant consists of a flowering stem two or three inches high, a few reniform leaves, and several slender runners bearing tiny bladder-traps and tubers. The point of main interest, as in other species, is the morphology of the runners in relation to that of the leaves. The simple view that the "leaves" are phyllomes and the runners caulomes is rejected, on account of the innumerable transitions between the two, and the fact that the bladders are found indifferently on both. The theory that the runners are specialised leaves has been strongly maintained by Goebel, but the author, Mr. Compton, favours the alternative interpretation, advocated by the younger Schimper, that the runners are of the nature of stems, and that the "leaves" have been derived from similar organs by a process of flattening—that they are, in fact, phylloclades. The question is one of much difficulty; the author puts his case well, but we take exception to the argument that his interpretation "is without the theoretical demerit of the contrary view, in that it does not tend towards an abolition of morphological categories." The question as to the modifications that may have taken place in the organs of the genus Utricularia must surely be decided without reference to the convenience of the theoretical morphologist.

(6) Mr. Bartlett's little paper is a description of two flowering shoots of the common woundwort, found at Medstead, in Hampshire, which showed certain floral abnormalities, increasing in degree towards the apex of the shoot. In the extreme cases the pistil was represented by two hairy, foliaceous carpels, usually united by their edges below, and bearing abortive ovules. This teratological condition confirms the conclusion, based on development, that the pistil of Labiatæ is really bicarpellary, though the ovary is quadrilocular. The floral axis produced at its apex, within the modified ovary, one or more flower-buds—a case of Masters's "median floral prolification." D. H. S.

THE PRODUCTION OF BLACKWATER FEVER.[1]

DRS. WAKELIN BARRATT and Warrington Yorke have pieced together the result of their investigations, in the form of a report, undertaken for the blackwater fever expedition to Nyasaland. The object of the work was to determine how blackwater fever is produced; in brief, it may be stated that the authors have failed to accomplish this object. Incidentally, the work was intended to throw light on many of the uncertainties connected with the fever, and in this respect they have succeeded.

In simple language, blackwater fever is a fever which occurs in persons who have been treated with quinine, usually for malaria, and the clinical connection between the fever and the quinine has been placed beyond dispute. The authors, after studying the processes of the dissolving up of red blood corpuscles under a large variety of conditions, adduce ample evidence to show that the alkaloid quinine can hæmolyse red blood cells, but that a direct action of the alkaloid in the body is excluded, because the concentration of the quinine in the blood plasma of persons under treatment for malaria is utterly insufficient to produce an ascertainable amount of hæmolysis.

Since quinine plays a part in producing this peculiar condition, but does not cause it directly, it was necessary to look farther afield for other ætiological factors. The authors have investigated the condition of the plasma itself, since in another disease, in which dissolved blood corpuscles are seen, the hæmolysis has been proved to be due to a substance in the serum known as hæmolysin. No trace of such a substance could be found in the serum of blackwater-fever patients. They leave this riddle unsolved, and turn to the question of the situation in which the hæmoglobin is set free. Proof appears to have been found that the site is the blood itself, and not the kidneys or urine, as had been supposed. Another fact which has been brought to light by the authors is that the only change which occurs in the kidneys in uncomplicated cases of the fever is the appearance of a brownish material placed in the lumen of the renal tubules. No degeneration or other indications of pathological conditions are to be found.

Various other points are dealt with, and the reading of the work is materially assisted by the publication of summaries at the termination of each chapter. The theoretical reasoning is well carried out, and the work, while failing to solve a difficult problem, certainly illuminates many contributory factors in the production of blackwater fever. H. W. ARMIT.

THE ORGANISATION OF TECHNICAL EDUCATION.[2]

THE position of higher education has altered immensely in the last ten years since I ceased to be intimately connected with teaching. In the first place, the number of agencies engaged in the work has multiplied, the number of students they attract has grown, and the funds at their disposal are greatly larger. At that time there were two universities in England, besides the old foundations of Oxford, Cambridge, and Durham—London University, a purely examining body, and the Victoria University at Manchester, uniting the three colleges in Manchester, Liverpool, and Leeds. Now, if we may reckon Newcastle in addition to Durham, there are seven, each well equipped, and with a staff of professors competent and anxious to advance knowledge and to train their students for the duties of life.

But, besides this, there is in almost every important town a technical school or college supported by municipal funds, in two cases at least outside London an integral part of the university, everywhere doing work which must be done if we are to maintain our position in the world.

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[1] "An Investigation into the Mechanism of Production of Blackwater." By Dr. J. O. Wakelin Barratt and Dr. Warrington Yorke. (Being the Report of the Blackwater Fever Expedition to Nyasaland of the Liverpool School of Tropical Medicine, 1907-9). *Annals of Tropical Medicine and Parasitology*, series T.M., vol. iii., No. 1, October. Pp. 256; with numerous illustrations and tables, &c. (Liverpool: University Press; London: Constable and Co., Ltd., 1909.) Price 10s. 6*d*.

[2] From the presidential address delivered to the Association of Technical Institutions on February 11 by Dr. R. T. Glazebrook, F.R.S.

I do not mean that these technical colleges are all new since 1899; most of them, possibly all, were in existence before that time, but their importance is now more fully realised, and the magnitude of their task more completely grasped, by those who are responsible for their maintenance and progress.

Turning to London, we have the University with its colleges, University College, King's College, and the East London College, struggling to realise under no small difficulties the ideal of a great teaching university, and doing it with increasing success; the Imperial Technical College, with its constituent parts; the Royal College of Science; the Royal School of Mines; and the City and Guilds College, which has just started with high aims on its difficult task; and the numerous technical colleges too many to mention, some of them old institutions inspired to new endeavours by the wise action of the Charity Commissioners, the generosity of city companies, the vivifying influence of the whisky money, or the foresight of the education authority for the county.

A list containing the names of these institutions throughout the country, showing the funds administered on their behalf, their staff of teachers, and their roll of students, would prove a formidable document, and if the list were compared with a similar one drawn up ten or fifteen years ago the amount of progress would be obvious. I am aware, of course, that if we compared it with a similar list drawn up for Germany or America, our numbers and resources would appear but small.

I do not direct attention to our growth in any spirit of self-glorification or with any view to suggest that we ought to be satisfied, but rather that you who are so well qualified to advise and to judge may take stock of the position, may ask yourselves whether your efforts are in all cases being well and wisely directed, what ought to be your aims, and what your own position relative to the other agencies around which have the same general object in view.

This is, I take it, the more necessary because of the probable large influx of additional work with which in the course of a few years educational authorities in all parts of the country will probably be called upon to deal, while here in London the need for some general consideration is the more urgent because of the work which the Royal Commissioners for the University of London are now engaged upon.

What are the aims which we whose work lies mainly with the technical institutions of the country have to set before ourselves? What is our position in the scheme of education which is gradually being evolved?

Now there are two sets of individuals, for each of which a somewhat different course of training is needed, those who are to be leaders in industrial pursuits and those who will ever remain among the rank and file. While it should always be possible for the workman to rise to the rank of leader—and your scheme of education must give full opportunity for this—the methods of a trade school aimed chiefly at giving to the workers in its district that fuller knowledge which makes their labour skilled must clearly differ from those of a college designed to give the highest technical training to those who are to lead and guide the workers.

M. Leduc, in a recent paper published in the *Bulletin de la Société pour l'Industrie nationale*—the Society of Arts of France—directs attention to the four-fold division of German instruction in technological science:—

(1) The comprehensive training which is to turn out the future captains and leaders of industry.

(2) The provision for putting trustworthy information on technological matters at the disposal of traders.

(3) Central institutions established for the scientific and practical study of special industries, and

(4) Local technical schools adapted to the special needs of particular localities.

In Germany, as we know, the great technical institutions have developed almost independently of the ancient universities.

The term university was, we are told, in the Middle Ages used to denote any community or corporation regarded under its collective aspect, but finally it came to mean a community of teachers and scholars whose corporate existence had been recognised and sanctioned by civil or by ecclesiastical authority, or by both. In its earliest stage it was probably a scholastic guild, a spontaneous combination of teachers and scholars formed on the model of the trades guilds or guilds of aliens, in great measure for mutual protection. In still earlier days learning flourished mainly, if not entirely, in the monasteries and cloisters, and the earlier universities took their rise in the endeavour to provide instruction beyond the range of the monastic schools. For the most part they were organised under the four faculties of theology, law, medicine and philosophy, or the arts, and they retained this constitution until the last century.

In Germany the activity and importance of the universities dates from the time after Jena, 1806, when, as we were reminded by Sir Norman Lockyer in his presidential address to the British Association in 1903, King Frederick William III. and his counsellors, among them Wilhelm von Humboldt, founded the University of Berlin "to supply the loss of territory by intellectual effort." In the main, however, it was founded on the ancient lines, and when later on in the century the problems of the application of science to industry had to be faced, and the technical high schools came into existence, they were developed independently of the universities.

By 1903 the separation from the universities had become definite. In Prussia the Emperor had recognised it by giving certain of the great schools the right to grant the degree of Doctor of Engineering, thus putting them on an equality with the universities, and by admitting the principals to the Prussian House of Lords, giving them the title of His Magnificence.

Now there are in Germany ten of these technical universities at Dantzig, Berlin (Charlottenburg), Aix, Hanover, Munich, Carlsruhe, Dresden, Stuttgart, Darmstadt, and Brunswick, all over the length and breadth of the land, with nearly 12,000 fully qualified day students between them, and more than 2000 in addition whose qualifications are not complete. Last year 1668 diplomas were granted, and of those who received the diploma 130 took the degree of Doctor of Engineering.

The age at which these students begin their work is from eighteen to nineteen years, and the "matriculation for fully qualified students at German technical universities is the completion of the full nine years' secondary-school course at a classical, semi-classical, or modern secondary school." Besides these, there are the twenty older universities, with 48,000 students, of which a large number study chemistry and, to use a Cambridge official phrase, "other branches of physics." The students work for four years, usually after a minimum period of one year in works, and the aim of the institutions is to train experts, inventors, high technical State and municipal officials, captains of industry, owners of great works, professors, secondary teachers, engineers, architects, chemists, &c.

Besides these ten technical universities, there are special engineering and other technical schools for the training of owners and managers of small works, foremen, clerks of works, surveyors, draughtsmen, and the like.

Now I have not referred to this merely to mark our own deficiencies, but rather to afford some guidance as to the lines along which we are to develop. Are we to look forward to the growth of technical universities in each town arising naturally out of the colleges with which we are connected, but independent of, and at the same time rivals of, the universities which in many cases exist already alongside our own colleges?

The answer to this question must, I think, be in the negative, with possibly one or two exceptions—we will put aside, for the present, London and the two ancient universities—it would, I think, be suicidal to suggest that in Manchester or Birmingham, Leeds or Liverpool, there should be two degree-giving bodies, one connected with the arts, literature, and pure science, the other with those applications of science on which industry depends; and for this reason, among others. The universities of England are modern creations animated by modern ideas, and controlled by men whose main endeavour is to bring home to the mass of their countrymen the blessings of knowledge. The seclusion of the mediæval cloister, the quiet of the monastery, or even of the courts and quadrangles by the Isis and the Cam are not for them. They are placed amid the busy haunts of commerce, close to the foundry and the workshop, and their students seek to draw from ancient learning and from modern research alike those lessons of truth, those unerring laws of nature in accordance with which we must progress if our country is to remain great, to hold the premier place among the nations.

These universities will do for us what the technical high schools have done for Germany.

Let me note one important difference between their constitution and that of the ancient universities. They are not Republics; the Senate, the general body of professors and independent lecturers, is not the governing body. The court, with which control ultimately rests, is a large body representing all interests in the town and district. The court selects the council, which has executive power, and on both bodies the teachers have representatives; but in this way the effective management of the university is in the hands of a small body of business men ready to give the fullest attention to the wishes of the teachers, but capable of bringing other qualities to the consideration of the complex problems with which they have to deal, experienced in dealing with men and with affairs.

The prospects of the modern universities of England are bright; it is our business in our technical schools to supplement by all means in our power the efforts they are making to solve a difficult problem. Those who are to speak to-morrow can tell you better than I how the task is being done.

But with all the progress we have made we are still far behind Germany in very many vital respects. I am aware that the standard of entrance at our universities is being gradually raised; it will be long indeed before it reaches the nine years' secondary-school course required in Prussia for admission to any of its four technical universities. Still, we may look forward with some certainty to the time when our universities will do the work for England that those four universities do for Prussia; and while in some cases the connection between the technical college and the university will be very close, it is well to realise that there is an immense task before us which cannot be touched by the universities. University work is, in the main, day work; it calls for the whole time, the whole energy of the student; it may be that for a time, in some of its preliminary stages, some progress can be made by evening work, but a full university course demands more time than a hard-worked man should give after his day's task is done. The marked feature of the technical college is its evening work, the education it provides for those who have by day to make their living, raising and improving the quality of their work by training their intelligences, by putting clearly before them the why and the wherefore of the processes in which they take part.

I am not sure whether statistics exist as to the number of these students, the classes they attend, and the work they do. I have seen figures for London, and no doubt they might be obtained for the country at large. Few among these students hope to reach university standard, nor should their teaching be planned as though this were the main object in view. They fall, it seems to me, into two main categories, the adolescents—to use the word of the continuation schools report—who have recently left school to commence some trade, and for whom the continuation schools are designed, and then the older workmen, who want to understand the work they do, to prepare themselves for posts as foremen or overseers, and to be given some wider outlook on life than the shop or factory affords. There is room for a large development of both these tasks, for more coordination of the work, and greater continuity of effort. Elementary technical education is needed in all our towns, technical universities are needed in a few great cities only; for these latter we must concentrate both students and teachers.

A scheme whereby the evening technical institutions of a district would look to a technical university in one of the main centres of population as their university, would organise their work in connection with the day classes of the university, and would confine their own ambitions within moderate bounds, endeavouring to do their work within those bounds with the highest possible efficiency, would do much for the real interests of the nation. To promote such a scheme ought not to be a task beyond the powers of this association. It is a national work, and one which should readily gain the assistance of the national authorities.

In any scheme two matters must be borne in mind. A system of bursaries and scholarships must open the university to any student who can sufficiently profit by the opportunity thus offered; this is generally admitted; but, in addition, it should be possible for the teachers to advance knowledge by research and study. To do this in each technical school or trade school is clearly impossible. If its importance were once recognised, it ought to be possible to arrange for facilities for the work for teachers in the district in the laboratories and class-rooms of the university.

Oxford and Cambridge are outside any such scheme; London, again, offers special problems of its own.

The two ancient universities need not detain us long. England owes so much to them, and English science so much to Cambridge in particular, the home of Newton, Young, Cayley, Stokes, Kelvin, and Maxwell, to name mathematicians alone, that one who realises all the benefits Cambridge can bestow upon her sons can only express the very deepest regret that the regulations of the University still close her doors to many young Englishmen on whose future she could exert an inestimable influence for good; still, even if an elementary knowledge of Greek were no longer necessary for entrance, Cambridge must devote herself rather to the study of pure science than to that of technics and engineering; students who go to Cambridge are prepared to spend time and money in gaining other advantages besides those of their technical education. Cambridge does not aim at being one of the great technical universities, but rather a home of sound learning and religious education from whence may spring great generalisations and new ideas to fertilise the world.

As to London, the problem is most complex. We have the university, the university colleges, now happily a part of the university itself, the Imperial Technical College, with its own constituent parts, the Royal College of Science, the Royal School of Mines and the City and Guilds College, the Finsbury Technical College, and the various polytechnics and trade schools. What, from our point of view, are to be their connections, and under what scheme can they best combine to meet the wants of the seven millions of people for whom they provide?

We have to provide for the masters and leaders of industry by institutions giving a wide and comprehensive training suited to their needs; we have to secure that the workers shall be able to gain the knowledge needed to make their labour fruitful to themselves and to the State, when young in technical schools adapted to the requirements of their trade, and when more mature in more highly specialised institutions organised to promote the scientific and practical study of special industries.

There is yet another class, limited in numbers, but valuable beyond measure to the State, those to whom it is given to advance learning—the potential Faradays of this great city.

For the first class we have the university, with its constituent colleges and parts; but are we to have one university or two? Shall London University embrace, as its name would imply, the whole of learning, the arts and sciences, literature, economics, theology, law, medicine, and the technical applications of science, or are we, like Berlin, to have two universities side by side, the one dealing with the older studies and pure science, the other the technical university, taking under its care those practical developments of science on which the welfare, nay, the very life, of the country hangs?

The matter is now under consideration, and this is, perhaps, hardly the place to discuss it. I would only say that the example set by Germany, though to follow it would entail many difficulties, is not lightly to be set aside. In any case, some change must come in the present government of the university—a change, I trust, which will place the executive control of its fortunes in the hands of a much smaller body than the Senate, will leave the various faculties more free to develop on the lines best suited to each case, and will concentrate more completely than is at present possible the highest studies, affording to its students the opportunities which they now lack for post-graduate study and original research.

At any rate, we may take it that the Imperial Technical College will become the technical university for London—whether as a part of London University or as a new university working alongside it does not for our present purpose matter—concerned chiefly with honours students entering with high qualifications for a three or four years' course, including post-graduate study and research.

While referring to research, let me say I do not think you can successfully command a college, either by Act of Parliament or by Royal Charter, to become the home of original research. You can foster the endeavour by your regulations and the proper provision of funds, but success depends mainly on the men who guide the students and direct their energies. It was Liebig who made Giessen; the physical laboratory of Berlin became famous because Helmholtz worked there; it was not the cellar in the old university buildings, or the funds available for inquiry, which drew students from all over the world to Kelvin's laboratory at Glasgow. Rowland and his staff are the real founders of the Johns Hopkins University; to-day it is Thomson who fills the Cavendish Laboratory and Ramsay who attracts our ablest chemists to a somewhat second-rate laboratory in Gower Street. To expect a distinguished body of post-graduate students to flock at once to a newly opened college is a vain hope; but this is a digression. The Imperial Technical College will in time become the technical university of London. To achieve all that is aimed at, time and a more generous support on the part of those who have interests of education at heart alone are needed.

To this university there must be many avenues of approach; it must spread its roots afield; among its students some—by no means all—will pass through the polytechnics, for it appears to me the primary work of the polytechnics is not to prepare undergraduates for degrees in science and engineering, but rather, in the first instance, to supply needful knowledge to the worker.

No doubt it is necessary that, in view of the size of London, there should be centres of university work in various parts; it is desirable that some of the polytechnics should organise themselves so as to meet this demand; but is it necessary for all to do so? I do not wish to express an opinion so much as to raise a question.

I think I realise in part the feelings of the teachers; their university students are, I take it, among their best; the chance of doing research work turns largely on having one or two such students, and research work must be done if your teaching is to be kept alive and your courses, at any rate to advanced students, made fruitful; but is the highest work, or even work up to degree standard in many subjects, to be attempted in every polytechnic? The expense of such a plan must be very heavy, the strain on the teachers enormous. Suppose that, instead of endeavouring to cover all the instruction required for the B.Sc. degree, each institution made a serious effort to specialise only in one or two of the required subjects, leaving the others to other polytechnics, would not this relieve the pressure? In this chosen subject the principal would draw round him a large and able staff who would attract students from a wide area, and his college might in time become a specialised school of technical research. The teachers in this subject would find in their work ample opportunities for investigations of real importance; in the other branches of science the work would be avowedly more elementary, and the teachers probably less competent to research: but if the classes were mainly evening, such of the staff as wished might carry on investigation in the central laboratories of the university, or possibly at some other polytechnic where the subject of the research was made a special object of study.

One point more. Among your many students are some of very marked ability, perhaps of genius. Ease their paths by all methods within your power. Let me urge on the governors of your various institutions, and on those who hold the purse, if there are any such who can hear me, that expenditure on scholarships or bursaries for such, on material and apparatus for their researches, will soon repay itself in the effect their work will have in applying science to industry and trade, in discovering new means whereby the forces of nature may be harnessed to do the work required by man.

To conclude; my dream would picture a central technical university for London, a place where students only of proved capacity were admitted, where the staff were free to conduct original investigations and through these to teach their students, where scholars and prizemen from the various technical institutions of the district were collected, and where the teachers in the polytechnics and other colleges were freely welcomed to carry out researches.

In close connection with this there would be a number of colleges, day colleges chiefly, organised so as to provide the teaching required for the less advanced stages of the university. The suitable centres for this work would, of course, need to be selected with due regard to geographical conditions. Beyond these, again, would come the polytechnics, engaged chiefly in evening classes for the worker, but each with its one or more departments organised so as to provide teaching and means for research of the highest character, with its teachers recognised by the university, having a common interest in promoting the welfare of the central body and looking to the professors as their leaders in the search for truth.

Whether this dream comes true or not, I am clear that a scheme for technical education in London must aim at coordinating existing effort round a central institution, and in this endeavour must recognise the self-sacrificing labours of those who, in the past ten years, have done so much to forward the great movement—the governors and the staff of the institutions represented on this association.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The general board of studies will shortly proceed to the appointment of a Stokes lecturer in mathematics, in succession to Prof. Hobson. The appointment will be from June 24, 1910, to September 29, 1913. The annual stipend is 200*l*. Candidates are requested to send their applications, with a statement as to the branches of mathematics on which they are prepared to lecture, and with testimonials if they think fit, to the Vice-Chancellor on or before April 25.

The Allen scholarship has been awarded to Mr. R. Whiddington, of St. John's College. Mr. Whiddington took a first class in physics in part ii. of the natural sciences tripos in 1908.

SIR ALFRED KEOGH, K.C.B., formerly Director-General of the Army Medical Service, has accepted the rectorship of the Imperial College of Science and Technology, and will take up his work at an early date.

A REUTER message from Bombay announces that Sir Carrimbhoy Ebrahim has given to the Bombay Government a sum of 30,000*l*. for the improvement of scientific training, the encouragement of research, and the provision of scholarships to science students of the Mussulman faith.

A MEETING of the London branch of the Mathematical Association will be held at the L.C.C. Training College, Southampton Row, W.C., on Saturday, March 19, at 2.30 p.m. Papers will be read on the teaching of graphs, by Dr. T. Percy Nunn and Mr. P. Abbott. A discussion will follow, which will be initiated by Mr. D. Mair. All who are interested in the work of the association are invited to attend.

THE Fresenius Chemical Laboratory, Wiesbaden, offers opportunities for the pursuit of study and research in chemical science in an attractive part of Germany. The directors of the institution are Prof. H. Fresenius, Prof. W. Fresenius, and Prof. E. Hintz, and there is a large staff of lecturers and assistants. The summer term will begin on April 25, and among the subjects of lectures announced are chemical technology, stöchiometry, microscopy and chemistry, and analysis of foods. Copies of the regulations and the syllabus of lectures may be obtained upon application to one of the directors of the laboratory.

THE Old Students' Association of the Royal College of Science, London, has commenced the publication of a *Record*, which is to be issued at irregular intervals as